



ANALYSIS OF CREATIVE THINKING SKILLS BASED ON COGNITIVE LEVEL

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Abstract

This study aims to describe students' creative thinking skills in solving mathematical problems reviewed from the cognitive level. The research was carried out at Putra Harapan Junior High School Purwokerto. The research method used is qualitative descriptive. Based on previous cognitive tests, students are grouped into cognitive levels, namely very good, good, good enough, not good, and not good. The instruments used in this study consist of written tests and interview guidelines. Data analysis techniques include data reduction, data presentation, and conclusion. The study results show that students in the very good and good category can meet the aspects of fluency and flexibility. Students can understand and work on the questions appropriately and confidently. Students of the excellent category can find many ideas and completion methods that can be applied correctly. The students who are quite good and those who are poor have difficulty finding solutions and using them in problems. Students in the not-good category cannot correctly fulfil the aspects of creative thinking, namely fluency and flexibility, and they have difficulties understanding the initial problem.

Keywords: Cognitive Levels, Creative Thinking Skills, Creativity.

INTRODUCTION

One of the skills that can be used to deal with the development of science and technology, which is developing very quickly in the 21st century, is creative thinking skills (Septikasari & Frasandy, 2018). Creative thinking is essential in various fields, including education, arts, science, and technology, because it helps individuals find solutions beyond conventional mindsets (Lestari et al., 2024). Creative thinking in mathematics education is the skills to generate new ideas, solve problems innovatively, and find many alternative ways to solve math problems. A concept or formula, if given directly, will become memorization, but if learning aims to find an idea, students must think critically and creatively. Creative skills are important because mathematics focuses on the result and how students understand and explore various problem-solving approaches (Artikasari & Saefudin, 2017).

The skill to think creatively is a mental process that involves the creation of new ideas, innovative solutions, and unique approaches to solving problems. Creative thinking consists of several important indicators. Two of the indicators are fluency and flexibility (Suardipa, 2020). The fluency aspect is related to the number of answers that are made and have the correct value. The flexibility aspect is the skill to produce ways or methods of solving problems that vary and can be applied

correctly to problems (Fitriarosah, 2016). The potential of students' creative thinking needs to be pursued, and an alternative must be found to help teachers develop students' creative thinking skills. If not created and formed, individual creative potential will be latent. One way to build and shape student potential is by analyzing and discussing how the student thinking process works. By revealing the creative thinking process of students, it is hoped that it will be an evaluation material for teachers to improve the next learning process. In addition, the results of this analysis can also be used as material to assess student needs in learning mathematics.

Several studies on creative thinking have been carried out, including Gunawan et al. (2022), explaining the characteristics of creative thinking skills based on confidence. Students with high confidence can connect mathematical concepts to obtain creative ideas. Still related to creative thinking, the research of Gunawan et al. (2023) explains the skills to think that are part of the creative process. Students with a good cognitive category can understand the initial problem correctly and develop some solutions to solve the open-ended problem. It shows that students' cognitive level provides comprehensive information related to the characteristics of creative thinking in solving creative problems. Research was also conducted by Rohaeti et al. (2019), which explained students' cognitive level towards creative thinking skills. The mental level consists of formal, transitional, and concrete. Students at the concrete level experience obstacles in solving creativity problems, while students at the formal and transition levels have good creative thinking skills.

Based on the background description, this study aims to describe the characteristics of students' creative thinking abilities based on their cognitive level in solving open-ended problems. The results of this study can provide important information to improve students' cognition in the learning process in the classroom.

METHOD

This type of research is qualitative descriptive research. This method describes the conditions during the research on integer operation materials. The subjects in this study are 23 students at SMP *Boarding School* Putra Harapan Purwokerto. The time of this research was carried out in the odd semester of the 2024/2025 school year. The instrument in this study is a description test consisting of 1 question, a mathematical creative thinking skills test, and interview guidelines.

Based on the results of previous cognitive tests, students were grouped into very good, good, moderately good, poor, and not good. Each level is taken as one person as an informant with *purposive sampling* (Sukestiyarno, 2020). Informants were labelled for excellent level (S1), good level informant (S2), quite a good level informant (S3), poor good level informant (S4), and not good level informant (S5). In this study, the researcher did not apply special treatment to students before or after the study.

The researcher collected data with open-ended tests on integer material and interviews. The test's design is to determine students' creative thinking processes. Before carrying out the test instrument, the researcher involved validators to check and study the question items. The results of the

validators show that it is valid and reliable to be used in the research. Researchers use interview guidelines to learn in-depth about creative thinking skills.

Researchers analyze data by reducing, presenting data, and concluding data. Researchers select, summarize, and focus on important information about students' creativity in the data reduction stage. In explaining the data, the researcher explained the test results and interview in pictures, tables, and interview excerpts with informants. This step requires the researcher to present the analyzed data and connect the data analysis with the results of other studies. The last stage is to conclude by comparing the data analysis, test, and interview results. The focus of conclusions is the characteristics of students' creative thinking abilities based on cognitive levels.

RESULTS AND DISCUSSION

At the beginning of the study, the researcher provided a creative thinking test. This test consists of 1 item of description questions. Based on the test results, the researcher grouped students into very good, good, moderately good, not good, and not good. Table 1 illustrates the results of each informant's creative thinking skills test.

Written test documents and in-depth interview results explain the characteristics of creative thinking skills. In this study, indicators of creative thinking skills consist of fluency and flexibility.

Table 1. Recapitulation of Informants' Creative Thinking Skills

No	Informants	Score	Score Criteria	Cognitive Categories
1	S1	100	$\text{Skor} \geq 90$	Excellent
2	S2	80	$80 \leq \text{Skor} < 90$	Good
3	S3	70	$70 \leq \text{Skor} < 80$	Quite Good
4	S4	60	$60 \leq \text{Skor} < 70$	Poor Good
5	S5	40	$\text{Skor} < 50$	Not Good

The criteria for determining cognitive categories are divided into five, namely very good, good, quite good, not good, and not good, as shown in Table 1 (Damanik & Syahputra, 2018). According to Putri et al. (2020), fluency and flexibility are achievement indicators that can measure creative thinking skills. Table 2 describes the two indicators.

Table 2. Indicators of Creative Thinking Skills

No	Indicators	Description
1	Fluency	Students can create more than one different answer and get it right
2	Flexibility	Students can use more than one different and precise method of solving problems.

The researcher uses integer material as the problem content. The question type adopts an open-ended approach. Figure 1 is an open-ended problem created and given to students to solve. This question consists of two questions, each measuring fluency and flexibility indicators.

1. Draw three different numbers between 1 and 9 so that the result equals 10. (*Fluency*)
2. Use those numbers to form mathematical operations (addition, subtraction, multiplication, or division). Name all the possible combinations. Write down some ways to solve it. (*Flexibility*)

Figure 1. Open-Ended Problems

Based on the results of the creative thinking skills test and interviews with informants, the following will explain each informant's characteristics regarding the skills to think creatively from the cognitive level.

Students with Excellent Cognitive Levels

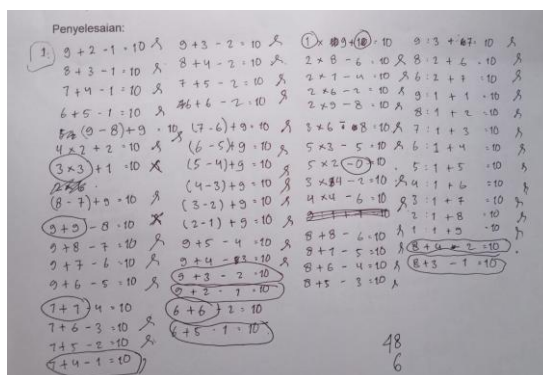


Figure 2. S1 Work Results

Figure 2 shows the results of the informant work that found the most solution ideas. He saw 60 ideas; it looks like the pattern he wrote down flows without burden, and he may be able to write more than that if time is added. The informant understands the questions and immediately searches for many ideas to find the right answer. In an interview with S1:

Q1: Of the 60 counting operations you made, are any repetitive? Do you know this?

Q1: I knew I had already written an operation, so I wrote it again. However, because I was focused on multiplying the answers and still had an idea to write another calculation operation, I ignored it first. When the time was almost finished, I forgot to correct and replace it.

Q2: There is an answer that does not follow the instructions. It uses the same number that you used to make the calculation operation. Are you aware of it?

Q1: I focus too much on the three numbers that must be used so that the result equals ten. Sometimes, I forget that there are different conditions.

Creative students have a high sense of curiosity, are rich in confident ideas, persist in achieving their desires, work hard, understand self-sufficiency, and like complex and challenging problems

(Hendriana et al., 2013). This S1 is very confident in working on issues and working on them happily, even though it requires many ideas to come out. Several answers do not match the question request, including repeating the same method and using the same two nagka in making integer calculation operations that should be different. Based on research, Lutvaidah and Hidayat (2019) explained that the lack of thoroughness in observing problems affects students' problem-solving skills.

Students with Good Cognitive Levels

Penyelesaian:

- $-5 + 7 - 2 = 10$ ✓
 $-5 \times 6 : 3 = 10$ ✓
 $-7 + 6 - 5 = 10$ ✗
 $-8 : 2 + 6 = 10$ ✓
 $-5 \times 8 : 4 = 10$ ✓
 $-5 \times 9 : 2 = 10$ ✓
 $-7 + 9 - 6 = 10$ ✓
 $-1 \times 9 + 6 = 10$ ✓
 $-1 \times 6 + 4 = 10$ ✓
 $-1 \times 7 + 3 = 10$ ✓
 $-1 \times 3 + 7 = 10$ ✓
 $-1 \times 8 + 2 = 10$ ✓
 $-1 \times 2 + 8 = 10$ ✓
 $-1 \times 9 + 1 = 10$ ✓
 $-1 \times 1 + 9 = 10$ ✓
 $-9 - 2 + 3 = 10$ ✓
 $-9 + 2 - 1 = 10$ ✓
 $-9 + 3 - 2 = 10$ ✓
 $-9 - 1 + 2 = 10$ ✓
 $-8 + 3 - 1 = 10$ ✓
 $-8 - 3 + 5 = 10$ ✓
 $-7 - 2 + 5 = 10$ ✓
 $-5 - 3 + 8 = 10$ ✓
 $-6 : 2 + 7 = 10$ ✓
 $-6 - 1 + 5 = 10$ ✓

Figure 3. S2 Work Results

Figure 3 shows the answers of S2 informants included in the good skills category. The informant did not get as many ideas as the first informant, who was so neat and systematic. This S2 informant took longer to determine the pattern and was not fluent in writing ideas. The informant felt sluggish at a certain time, which was confirmed by the following interview.

Q1: Why do the numbers 5, 7, and 2 appear in the first answer?

Q2: Because what comes to my mind is that number. I chose the easiest calculation operation as an example or prefix to provoke other numbers.

Students with Quite Good Cognitive Levels

Penyelesaian:

- $9 \times 1 + 1 = 10$ ✓
 $7 \times 2 - 4 = 10$ ✓
 $5 \times 3 - 5 = 10$ ✓
 $6 : 2 + 7 = 10$ ✓
 $8 : 4 + 8 = 10$ ✓
 $3 - 1 + 8 = 10$ ✓
 $2 \times 4 + 2 = 10$ ✓
 $1 \times 1 + 9 = 10$ ✓
 $9 - 1 + 2 = 10$ ✓
 $5 + 6 - 1 = 10$ ✓
 $8 - 5 + 2 = 10$ ✓
 $2 + (2 \times 4) = 10$ ✓

Diagram: A 3x3 grid with numbers 1, 2, 3 in the first row, 4, 5, 6 in the second row, and 7, 8, 9 in the third row.

Satu / banyak dari bagian kanan, kiri, atas, bawah, atau persegi yg dibagi sama untuk membuat bagian, atau.

Gambar 4. Hasil Jawaban S3

Figure 4. S3 Work Results

Figure 4 is the result of the settlement of the informants who entered the group; it was quite visible that there was doubt in writing down the idea because there were traces. Informants need to analyze the problem before writing down the solution idea. It has not created a pattern, so it has been unable to write more solution ideas. Only 19 ideas can be written. Results of interviews with informants:

Q1: *Why did the first answer to the question have been deleted?*

Q3: *I thought I was only told to pick three numbers to operate. Then, the number of three numbers meant that it included the answer, so there were three wrong answers. Try to follow instructions one by one, not a unit.*

Q2: *Why do you start with three numbers: 3, 9, and 2?*

Q3: *At that time, the number was imagined.*

Q3: *Why make the counting operation random and not complete the addition and subtraction until it switches to other counting operations?*

Q3: *Because the question of being free does not have to be in order, I do it freely and not in order.*

In line with the research, Salsabila et al. (2023) explained a positive correlation between numeracy literacy and creative thinking skills. It means that students who understand problems well can think creatively and better. The length of the process of understanding the question affects the number of alternative answers because their thinking is limited by time.

Students with Poor Cognitive Levels

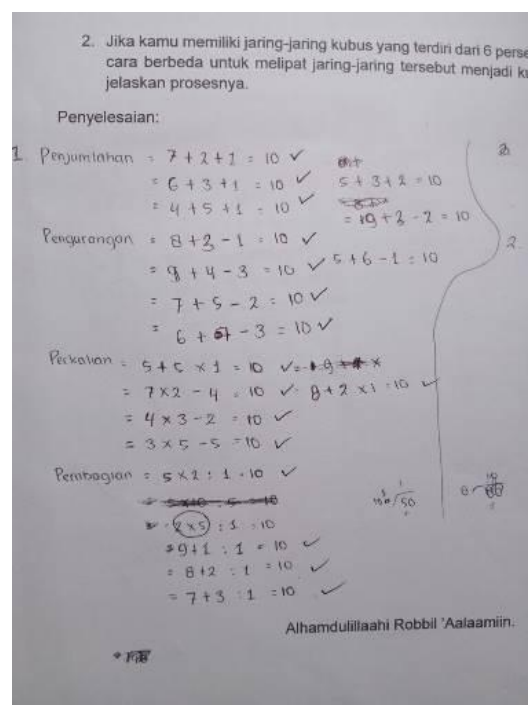


Figure 5. S4 Answer Results

Figure 5 proves that the answers written by the informants included in the cognitive skills are lacking. The informant can answer as many as 16 answers correctly. How to do it is quite systematic: Write down the type of calculation operation even though it is not yet detailed. That way, it can help him find solution ideas. The pattern of calculation operations has not been formed, so it has not been able to create many ideas. The results of the interview with the informant are presented as follows.

- Q1: *Why do the first numbers you use to calculate the operation start with 7, 2, and 1?*
 Q4: *I start with easy numbers and combine large numbers with small ones to get 10.*
 Q2: *Why did you write the name of the calculation operation inconsistently with the calculation operation you made? For example, you wrote subtraction, but in the operation, you used to mix with addition as well as multiplication and division that you wrote.*
 Q4: *Yes, at first, I thought there should be no mixed counting surgery, but after asking a friend, it was okay to combine the surgery.*

Students with Not Good Cognitive Levels

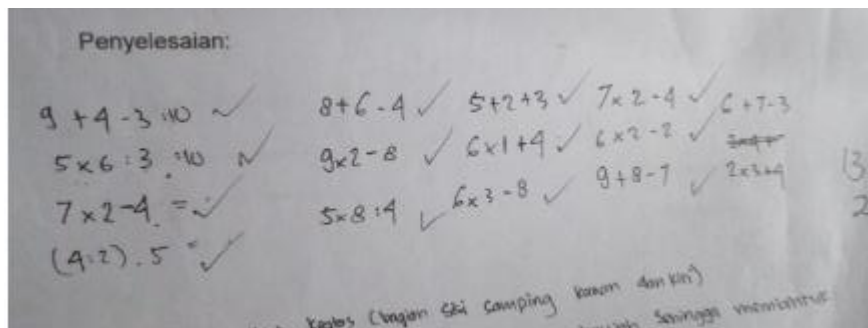


Figure 6. S5 Answer Results

Figure 6 illustrates the results of the work of group informants with poor cognitive abilities who only wrote 13 out of many alternative answers compared to group 1 informants, which is quite a big difference. The answer is not patterned and has not been systematic in answering. Results of interviews with S5 informants.

- Q1: *Why did you choose 9, 4, and 3 to start writing the calculation operation?*
 Q5: *That number first came to my mind.*
 Q2: *The first calculation operation is addition and subtraction; there are still so many number combinations that we can use to make addition and subtraction calculation operations; why do you immediately switch to multiplication and division?*
 Q5: *Since I followed the instructions for the problem, I sorted after addition and subtraction and continued with multiplication and division. I did not devise the idea of multiplying the addition and subtraction calculation operations first and then switching to other operations. I saw that my friend's answer was not too much, so I did enough. I am also lacking enthusiasm for working on this problem.*

Q3: *Why don't you write the same sign as some calculation operations, even though it can be the wrong answer in mathematics?*

Q5: *Yes, at that time, I thought that because the problem had to be 1, the operation I made must automatically be the answer to*

The research. Hendriana et al. (2013) explained that students with poor cognitive abilities have not yet developed high curiosity and dislike challenging problems, hindering their creativity. Concept understanding must also be matured because it affects students' ability to answer questions correctly.

CONCLUSION

The mathematical creative thinking skills of level students are very good, and they have the skills to meet the aspects of fluency and flexibility. Students at a fairly good level have not been correct overall in achieving the indicators of creative thinking skills. Poor-level students have shortcomings in understanding problems and finding solutions. Students' lack of initial skills is an obstacle to finding creative ideas. To improve students' mathematical creative thinking skills, teachers should explore students' initial knowledge and understanding of creative thinking and get them used to working on problems with many answers and many solutions that can be applied. Further research can be continued in examining the profile of students' creative thinking abilities reviewed from initial knowledge in solving contextual problems and HOTS.

ACKNOWLEDGEMENT

The researcher expresses appreciation and thanks to Universitas Muhammadiyah Purwokerto and Universitas Bina Bangsa for their contribution to the smoothness of this research.

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